DOCUMENT RESUME

ED 465 591 SE 066 289

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TITLE Building a Community for Science.
PUB DATE 2001-00-00
NOTE 15p.; In: Developing Teacher Leaders: Professional Development in Science and Mathematics; see ED 451 031.
AVAILABLE FROM ERIC Clearinghouse for Science, Mathematics, and Environmental Education, 1929 Kenny Road, Suite 200, Columbus, OH 43210-1080. Tel: 800-276-0462 (Toll Free); Fax: 614-292-0263; Web site: http://www.ericse.org.
PUB TYPE Reports - Evaluative (142)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Elementary Secondary Education; *Faculty Development; *School Community Relationship; Science Instruction; *Science Teachers

ABSTRACT

Professional development for effecting school change and school improvement is a community endeavor. While effective professional development requires all components of the local setting to be considered, the complexity of the educational system prohibits simple solutions. Building a community of leaders helps insure success in the change process. Leaders can be teachers, principals, administrators, and individuals in the community. This chapter describes an on-going 25-year professional development program for improving science education in the Anchorage School District. The development and maturation of the program are described as well as the impact on the program from various school and community members. Strategies to involve teachers, principals, central office staff, superintendents, boards of education, and related school and community members are identified. (Contains 20 references.) (Author/MVL)

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6 Building a Community for Science

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Professional development for effecting school change and school improvement is a community endeavor. While effective professional development requires all components of the local setting to be considered, the complexity of the educational system prohibits simple solutions. Building a community of leaders helps insure success in the change process. Leaders can be teachers, principals, administrators, and individuals in the community. This chapter describes an on-going 25-year professional development program for improving science education in the Anchorage School District. The development and maturation of the program are described as well as the impact on the program from various school and community members. Strategies to involve teachers, principals, central office staff, superintendents, boards of education, and related school and community members are identified.

Excellence in student achievement is a goal of the science education community (American Association for the Advancement of Science [AAAS], 1989, 1993; National Research Council [NRC], 1996; National Science Teachers Association [NSTA], 1993). Efforts to improve science education, however, create many questions. What does excellence mean? Where are the resources to insure that teachers have the necessary skills, materials, curriculum, and equipment to teach what needs to be taught? Who is really responsible for putting a program in place? What is the role of the school administrator? What is the administrator's role in empowering teacher leaders? These are all questions that seem simple yet are incredibly complex. Issues of policy, practice, and implementation of programs are intricately linked to the above questions. This chapter, which focuses on engaging an

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educational community in improving science education, will provide some insights that may shed light on these questions.

The complex nature of these questions prohibits simple solutions. Professional development is key in beginning to seek answers for these questions. To provide quality professional development all components of the local setting, such as cultural and organizational features, must be considered (Fullan, 1993). From this practitioner's view, there are several things which appear evident when looking at professional development. First of all, professional development often depends upon the involvement of various speakers to deliver the content. Having a dynamic speaker can provide motivation; however, if the speaker's objectives are not linked to the goals of the school or district, the opportunity to reinforce the direction that leads to improvement is lost. Careful consideration must be given to guarantee that each aspect of professional development contributes to the goals of the district or school. Second, in looking at the past, it is clear that educational change cannot be made one teacher at a time. Traditional approaches typically provide professional development for one teacher, send the teacher back to the school, and hope that changes will be made. However, without administrative support, buy-in, and continued attention, the chance of such efforts achieving success is very low. A well-developed plan for professional development involves administrative support to convey deliberate strategies for change (Loucks-Horsley, Hewson, Love, & Stiles, 1998; NRC, 1996; NSTA, 1993; Wilkes, 1994).

For professional development to ultimately impact student learning and thus achievement, it needs to be well planned, continuous, and aligned with the goals of the school and district (Loucks-Horsley, 1995). These goals must focus on students and their learning as the foundation for professional development (NRC, 1996). For long lasting school improvement, systems thinking provides a useful way to look at change. The framework for systems thinking (Senge, 1990) requires examining the whole instead of parts and views participants as responsible for shaping their own future and reality.

This shift of mind requires substantial change. This type of change is a process, not an event where leadership is the essential ingredient (Lieberman, 1988). What is leadership? Roger Bybee (1993) developed a useful characterization of what leadership includes:

- Making things happen or not happen;

- Getting others to do what they ought to do, and like it;
- Making people think things are possible that they didn't think were possible;
- Getting people to be better than they think they are or can be;
- Inspiring hope and confidence in others to accomplish purposes they think are impossible;
- Perceiving what is needed and right, and knowing how to mobilize people and resources to accomplish these goals;
- Creating options and opportunities, clarifying problems and choices, building morale and coalitions, providing a vision and possibilities of something better than currently exists; and
- Empowering and liberating people to become leaders in their own right. (p. 56)

Leaders in this change process can be teachers, principals, administrators, and members of the community. In considering the roles of administration, we must be aware that by virtue of position, there are several different layers of administration in the educational community. Assuming that systems thinking is valid, then special attention needs to be focused at each level. By their very nature and long practice of hierarchical organizations, many school districts try to make changes by mandating professional development and curriculum. This is often done without the knowledge or involvement of principals and teachers. This is counterproductive to research that indicates that mandating change is one of the least effective ways to accomplish goals (Fullan, 1993, 1997). Effective change (Hord, Rutherford, Huling-Austin, & Hall, 1987; Lieberman & Grolnick, 1997; Loucks-Horsley, 1997) must be the result of the whole system being involved in the process. Instead of defining roles for the principal, central office staff, superintendent, and the board of education, it is more productive to engage the whole community in striving for excellence in science education.

As one considers the educational community, it becomes apparent that there are many layers of influence. Universities, boards of education, municipal, state, or federal political bodies have profound effects on the education of our students even though they frequently have no direct contact with the classroom. Even at a school district level, some members of the educational community are still some distance from the classroom. However, through their direction, hiring

policies, building management, and curriculum development, staff has an effect on what and how programs are delivered. Then at the individual school or building level, principals are extremely important in setting the tone. They can support or become barriers for effective teaching practices (Zinn, 1997). Ultimately, all of these members of the educational community affect the classroom teacher who has the awesome responsibility of teaching students content and processes in a way that empowers them to become life long learners.

It is well documented that the principal's role in improving instruction is critical (Hall & Hord, 1987; Parker, 1997). There are many ways principals can facilitate professional development and ultimately influence the direction of school programs. Such influence ranges from being passive and not getting in the way of teachers who are involved in improving their school programs to actively being the visionary who is the curriculum leader. In a study by Bauchner and Loucks (as cited in Anderson & Pratt, 1995), 108 principals listed the type of assistance (in descending order of frequency) they provided their teachers:

- Communication with staff
- Plan, schedule and organize
- Provide resources
- Leverage staff
- Provide support
- Attend training sessions and meetings
- Observe the program in classrooms
- Handle paperwork
- Arrange training
- Communicate with external facilitators
- Audit program
- Make recommendations. (p. 155)

These various types of support indicate the profound influence which principals can exert in impacting the curricular activities within their schools.

In order to understand the role of the community in the change process in improving science education, the following case history is offered. The case history illustrates the involvement of one school

district and community in the development and implementation of an elementary science program.

Anchorage School District, 1974-Present: A Case History

Building a Community for Science

In 1974 the Anchorage School District did not have a comprehensive elementary science program, as such there were no elementary adopted texts or programs to guide the delivery of science for the district. For example, some schools had old texts that contained statements such as "someday man would walk on the moon," while other schools used Science Curriculum Improvement Study (SCIS) kits, Elementary Science Study (ESS) kits, or Science A Process Approach (SAPA). A 1973 survey focusing on the elementary school science programs in the district showed that there were 21 different "programs" which ranged from teacher-written lessons and commercial curricula to the absence of science being taught in some classrooms. Yet, some of the schools had outstanding teachers who were interested in making sure that their students had science learning experiences. For the most part, however, these teachers were few. Though some teachers and principals had been involved in National Science Foundation (NSF) institutes, there was no formal plan for these trained individuals to share what they had learned with others. What content was taught and how it was taught was left up to individual teachers with the end result often being that science was a neglected subject.

Ultimately, the district decided that this situation could not continue, which led to the hiring of the first science coordinator. When the coordinator left the following year, the author assumed the science coordinator's position. To assist in trying to define what should be taught, a classroom teacher was given a Career Development Leave (CDL) for the 1974-75 school year. The CDL teacher's responsibilities concentrated on meeting with staff, presenting lessons for students, and teaching credit courses for teachers. The road leading toward a sound science curriculum for elementary students was being built.

In 1975, the district's central office staff decided that a science program for elementary education was a priority. Influenced by text-driven approaches to teaching science, the Science Coordinator was given the task of finding a good text. She attended the 1975 National Science Teachers Association (NSTA) convention and used

the opportunity to network with other science leaders. At this time (1975), elementary science was not a priority in the nation's schools; many school districts were not supporting elementary science instruction. There was, however, a notable exception--the innovative program developed by the Highline school district of Seattle (cited in *Science for All Children*, NSRC, 1997). The Highline program was kit based with units that had been either locally developed or adapted from national science programs. In addition, there was a science center where kits were refurbished before being sent to other teachers. This provided a management system that supported teachers in their teaching of hands-on science. Impressed with the innovative nature of the program, the Anchorage Science Coordinator initiated discussions with the Highline Science Coordinator in order to obtain information about their curriculum and resources.

To help with the reform effort, the Highline Science Coordinator was hired as a consultant for the Anchorage School District for the 1976-77 school year. Part of his responsibilities included meeting with teachers, selected principals, central office staff, and other key people, such as the audiovisual (AV) director for the school district to provide them with information about implementing such a program in Anchorage. During this time the consultant shared his vision for effecting change in science instruction.

A pivotal development in the Anchorage school district came in the formation of a principals' support group comprised of principals who had expressed an interest in science education. Subsequently, the elementary director, the CDL teacher, and the Science Coordinator invited seven principals to serve as an advisory committee. The principals soon realized that elementary science should be hands-on and that teachers need support through the availability and maintenance of materials. Luncheon meetings provided a forum for conversations among these professionals as they grappled with solving problems and engaged in heated discussions. It became evident that conducting these meetings during lunch and providing food contributed to creating enthusiasm and building a community.

At the same time that the principals were having their monthly meetings, teachers and a principal representative were involved in an Elementary Science Curriculum Committee charged with developing a scope and sequence for elementary science. Their meetings were spent in essentially the same way as the principals--discussing what should be taught and how it should be taught. The meetings contributed

to growth in understanding of what constitutes effective science instruction. Consequently, additional support was gained for the development and maintenance of a comprehensive science program.

Other members of the community were also essential players in the development of Anchorage's elementary science program. Early in the effort, a group of community members formed an organization named, "The CommittEE," (where the EE represented Environmental Education). The CommittEE was interested in working with the district and in providing support for a quality science and environmental education program. For example, The CommittEE developed an Outdoor Week that provided each sixth grade class and teacher with the opportunity to spend a day at the Bureau of Land Management site where they experienced hands-on interactions with professionals from many different agencies and organizations. For example, students learned about plant identification, Alaskan animal behavior, orienteering, and other science-related topics. Additionally, The CommittEE was instrumental in providing important media attention for the science program. This media attention raised the level of community awareness about the importance of science to children and provided education about the role of the larger educational community in shaping the science program.

Concurrent with the activities of the principals, curriculum committee, and The CommittEE, professional development with university credit was offered by the district. The staff development department helped by providing presenters for inservice and facilitating one-credit university courses which included cutting edge science educators such as Harold Pratt, Harry Wong, Virginia Johnson, the late Mary Budd Rowe, as well as local science educators.

In January 1977, the AV director offered to offset the costs of establishing a science center by providing some funding. With $19,000.00 budgeted for materials, preparation began for establishing this central component in the District's plan to improve science education. During the next year, the Science Coordinator adapted and revised the Highline school district's elementary science curriculum, ordered materials, located a home for the science center, collaborated with principals to set up a pilot program, teamed with the Elementary Director to convert the CDL teacher into a teacher expert, and reached out to involve the various stakeholders in order to promote a feeling of ownership.

The principals in the advisory group felt so strongly about the benefits of the newly developed science program that each of the seven principals offered one-seventh of a Full Teacher Equivalent (FTE) in order to fund a teacher expert position. This position was different from the CDL position in that the teacher expert was to work exclusively with the seven schools and not the whole district. The teacher expert worked with the Science Coordinator and met with teachers and principals at each of the seven schools to "sell" the program. To be a part of the science center program, each school was required to donate their science equipment and materials to the science center to be used in the kits. Each school also committed to scheduling visits by the teacher expert who modeled lessons in the classrooms. The audiovisual department, through a federal program, funded a science center clerk and provided space for establishing the center. In January 1978, the first kit was delivered through the AV delivery system. The program was like a toddler--beginning to walk.

The principals involved in the program shared their excitement about the program with other principals. It was shortly after the first kit was sent out that the Science Coordinator began receiving calls from other principals interested in becoming a part of the science center program. These schools were recognizing some of the advantages of the new program--not having to order textbooks, not having to provide petty cash for those teachers who wanted to do their own activities, not having to find a place for or to manage science materials at the school, and most importantly, having a rich science program to teach in their classrooms. The following year there were 11 schools which opted to participate in the program, each offering a part of a FTE, resulting in allocations for an additional teacher expert. By 1979, twenty-five schools were participating and two more teacher experts were hired. The teacher experts continued to provide demonstration lessons, to be available to work with individual teachers, to write and revise curriculum, and to teach one-credit university courses.

Within five years, all the district's elementary schools were participating in the science center program. This remarkable growth and the far-reaching community support led to actions that institutionalized the program. The board of education, in a policy decision, officially sanctioned the science center program and mandated the teaching of four units per year in each elementary classroom. The district then assumed the responsibility for funding four teacher experts, for housing the Science Materials Resource Center, for funding four

clerks who maintained the kits, and for the delivery system including a truck and full-time driver. The science center delivered the kits to the teachers, picked them up on a specified date, refurbished the kits, and then sent them on to other teachers.

Although the program became an official part of the district's curriculum, it was critical to maintain the involvement of the educational community which had labored hard to bring about such change. Due to funding limitations, there were times when the program was being developed that the help necessary to put the science kits together was unavailable. An example of continued community support came in the form of The CommittEE who stepped in and helped assemble the kits. Members would come to the science center after work and donate two to three hours of their time. It was always a new experience, because the activities were often completely out of the ordinary such as plucking feathers from dead frozen ducks, assembling a kit that had twigs that had been "moose browsed," or counting out and shellacking moose droppings. The sense of community was exemplified by the willingness of the participants to provide meals during these work sessions. As a result of the superb efforts of the science center in sustaining the program, the center obtained state and national recognition, which resulted in three of the teacher experts as well as the Science Coordinator teaming with the National Science Resources Center in the development of its national program.

The development of the elementary science program, the involvement of the central office, and the change process for the teachers were not easy or simple. The science center went through scrutiny each year as budgets were approved. One year, all the teacher experts were eliminated and the program had to run with only the clerks, a driver, and the Science Coordinator. The program survived, and the next year funds were found to fill the position of one teacher expert.

These transitions and the maturation of the program provide many valuable lessons. One factor that became apparent was that the teacher experts giving demonstration lessons was not the best way to help classroom teachers become more comfortable with teaching hands-on science. In too many instances the classroom teachers perceived the teacher experts' demonstration as the science program. This realization was a primary factor in the reconsideration of professional development for teachers. Until 1993, most of the professional

development for elementary teachers was voluntary which meant that teachers who were reluctant and resistant to teaching science were not necessarily being reached with quality professional development. Principals also began to vocalize the need for all teachers to have more professional development that led to meetings with the principals and the Science Coordinator. From these meetings, it was evident that the first challenge was to provide a systematic professional development program which would directly impact all elementary teachers.

Consequently, the district wrote and submitted a proposal whose primary purpose was that of providing a systematic professional development program for the district's 1500 elementary teachers. In 1994 the proposal was funded by the National Science Foundation (NSF # ESI 9454411). The principle investigator for the project and the teacher experts were hired to provide the professional development component. The NSF expectation was for all elementary teachers in the district to participate in 100 hours of training. It was also expected that principals would be involved in the professional development program. While principals did not participate in all professional development activities, it is safe to say that each principal participated at least one third of the time.

The implementation of a quality science program in the Anchorage District has been successful to a great extent due to the support and ownership of the elementary principals. Research substantiates that skillful principal are key in improving science education (Fullan, 1993; Lieberman & Grolnick, 1997; Loucks-Horsley, 1997). Today, the program is intact with all the Anchorage School District's 60 elementary schools involved in the delivery of a quality science program. In retrospect, the benefits of the early involvement of teachers, principals, the Science Coordinator, and community members in a new program cannot be overemphasized as they are critical when striving for district-wide sustainable change.

Lessons Learned from the Anchorage Experience

The strategies used in building a community for science in the Anchorage School District included the involvement of teachers, principals, central office staff, superintendents, boards of education, and community members. As the program matured, it became evident that the success of the program hinged on the involvement of all members of the educational community. Several valuable lessons emerged from the Anchorage experience, providing strategies for

enhancing community support in building and implementing new programs.

First of all, principals can provide support for teachers in a variety of ways. This support empowers teachers engaged in educational change. In the Anchorage district principals demonstrated support by providing time for study groups, involving teachers in decision making, and providing professional growth opportunities for teachers.

Study groups are a way of providing the time and incentive for teachers to explore ideas, problems, and innovations. The outcome of these meetings can drive a program. In order for these study groups to be successful, teachers must be comfortable in taking risks and sharing their problems, successes, and ideas.

Teachers can be involved in decision making by serving on committees allocating budget and resource utilization. Examining school goals and the resources that are available to accomplish them helps both the principal and teachers. Holding grant workshops that provide a focus on writing and submitting proposals allows teachers and principals to actively think about what they feel is important. Clarifying goals for a proposal involves teachers and principals in decision making. Additionally, budget development is useful in providing a mechanism for goal clarification. Teachers can take the lead in planning how professional development will happen at their school, by examining goals and developing a program to support the active involvement of all teachers, thus enhancing teacher ownership of the program.

An excellent way to empower teachers is for principals to encourage teachers to apply for professional experiences in which they have an interest. For example, one teacher asked for and received some limited funds to study dinosaurs in Montana. She returned to her school and shared her ideas, materials, and equipment; consequently, the entire school benefited greatly from her summer of study.

Further, it is vital to involve superintendents, boards of education, and central office staff in the entire process of curricular change. When working with these stakeholders, it is advantageous to consider the size of districts since this can influence the nature of the selected activities. In general, larger districts have developed more procedures to follow than smaller districts. Regardless of the size of the district, it is important to understand the structure and to work in a cooperative manner. Superintendents are the designated leaders of school districts and need to be kept aware of the newest trends, developments, and

programs. Since professional development decisions often reflect the direction and goals of the superintendent, it behooves the science education community to keep awareness levels of science education highly visible to the superintendent. Working with the superintendent, it is the primary task of the board of education to allocate resources to provide the best educational system for students. Such decisions create multiple demands on boards who may or may not have an understanding of effective science education. Strategies to increase the awareness of the importance of science education are critical when working with superintendents, and local and state boards. However, a caution must be noted since some districts may have strict rules about contacting board of education members. By all means, work within the system. Leaders in science education must initiate action towards better communication through the proper channels.

Some specific strategies for working with the superintendent, boards of education, and central office staff include the following:

Form partnerships. Work together on projects, share information about what you are doing, and invite them to your meetings and celebrations.

Prepare completely for any meeting. Clearly outline the goals, objectives, timeline, cost, and outcomes of requests or proposals.

Seek professional opportunities that could involve local educational leaders. Provide information about science conventions and invite central office staff, superintendents, or members of the board of education to attend local and state conferences and conventions or ask individuals to serve as speakers for a session. Many of the NSF projects require that the superintendent be involved; the National Science Resources Center (1997) has conducted leadership conferences for many years and expects the superintendent or assistant superintendent to be a part of the team.

Invite these leaders to functions that celebrate students' and teachers' work in science. An invitation to a science fair highlights the importance of the event. Provide science journals for them to read in order to increase their familiarity with science programs and materials.

In addition to these lessons, there are some general words of encouragement, which are important to keep in mind. Though the advice sounds cliché, it is easy to become frustrated when taking on such a monumental endeavor. Start small. It is easier to build up a good program step by step than to try to make wholesale changes.

Success builds on success. Celebrate successes. Being on a winning team is an important aspect of building a community. Do not be discouraged when setbacks occur. Learn from the challenges and failures then revise the plans.

Conclusion

The collaborative experiences of teachers, principals, the Science Coordinator, and the community in improving science education in the Anchorage School District provide insights for professional development. Effective professional development builds a community of learners who can support and facilitate change. Resources, however, must be available for the professional development component. This does not mean that we can not accomplish our goal if we do not have funds, but it might require reassigning our resources. A good example is the donation of volunteer time from The CommittEE. Further, take advantage of the resources that are available. An example is that the Anchorage school district science center started in the AV hallway. When it was apparent that this program had potential for improving elementary science education, space was found to expand the actual facilities for the equipment, materials, kits, and clerical staff. In addition, examine approaches that enhance the leadership potential of all teachers. Even when there are teacher experts and resource teachers, they should support not replace the role of the classroom teacher in teaching science. In general, careful analysis needs to be done in order to best utilize human resources.

Systemic change is possible in education, however, change does not happen overnight. It is a complex process requiring the involvement of the whole community if change is to be sustained. To actually make differences that improve science education, all players must be involved in building the community. Another key factor in systemic change is the role of professional development with the goal of providing a quality science education for all students. A well-designed plan of professional development, such as the one that has been used for 25 years in Anchorage, is essential if a school system is to assist all students in becoming scientifically literate.

References

American Association for the Advancement of Science (AAAS). (1989). *Science for all Americans.* New York: Oxford University Press.

AAAS. (1993). *Benchmarks for science literacy.* New York: Oxford University Press.

BEST COPY AVAILABLE

Anderson, R., & Pratt, H. (1995). *Local leadership for science education reform.* Dubuque, IA: Kendall/Hunt Publishing Company.

Bybee, R. (1993). *Reforming science education: Social perspectives and personal reflections.* New York: Teachers College Press.

Fullan, M. (1993). *Change forces. Probing the depths of educational reform.* Bristol, PA: Falmer Press.

Fullan, M. (1997). Emotion and hope: Constructive concepts for complex times. In A. Hargreaves (Ed.), *Rethinking educational change with heart and mind, Association for Supervision and Curriculum Development (ASCD) 1997 yearbook* (pp. 216-233). Alexandria, VA: Author.

Hall, G. E., & Hord, S. M. (1987). *Change in schools: Facilitating the process.* Albany, NY: State University of NY Press.

Hord, S. M., Rutherford, W. L., Huling-Austin, L., & Hall, G. E. (1987). *Taking charge of change.* Alexandria, VA: ASCD.

Lieberman, A. (1988). Expanding the leadership team. *Educational Leadership, 45* (5), 4-8.

Lieberman, A., & Grolnick, M. (1997). Networks, reform, and the professional development of teachers. In A. Hargreaves (Ed.), *Rethinking educational change with heart and mind, 1997 ASCD yearbook* (pp. 134-149). Alexandria, VA: ASCD.

Loucks-Horsley, S. (1995). Professional development and the learner centered school. *Theory Into Practice, 34* (4), 265-271.

Loucks-Horsley, S. (1997). Teacher change, staff development, and systemic change: Reflections from the eye of a paradigm shift. In S. N. Friel & G. W. Bright (Eds.), *Reflecting on our work: NSF teacher enhancement projects in K-6 mathematics* (pp. 134-149). Lanham, MD: University Press of America.

Loucks-Horsely, S., Hewson, P. W., Love, N., & Stiles, K. E. (1998). *Designing professional development for teachers of science and mathematics.* Thousands Oaks, CA: Corwin Press.

National Research Council (NRC). (1996). *The national science education standards.* Washington, DC: National Academy Press.

National Science Resources Center (NSRC). (1997). *Science for all children: A guide for improving elementary science education in your school district.* Washington, DC: National Academy Press.

National Science Teachers Association (NSTA). (1993). *A strategy for change in elementary school science.* Proceedings of a conference. Arlington, VA: Author.

Parker, R. E. (1997). Comprehensive school and district restructuring of mathematics: Principles and caveats. In S. N. Friel & G. W. Bright (Eds.), *Reflecting on our work: NSF teacher enhancement projects in K-6 mathematics* (pp. 238-246). Lanham, MD: University Press of America.

Senge, P. (1990). *The fifth discipline: The act and practice of the learning organization.* New York: Doubleday.

Wilkes, D. (1994). *Schools for the 21st century: New roles for teachers and principals.* Greensboro, NC: SouthEastern Regional Vision for Education.

Zinn, L. F. (1997, March). *Supports and barriers to teacher leadership: Reports of teacher leaders.* Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.